



**REMARKS**

This paper is being submitted in response to the Office Action mailed July 31, 2006. Claims 9, 13, 14, 15 and 24-27 are pending in this application. In this amendment, claims 1-8, 10-12, 16-23, and 28-29 are canceled without prejudice to or disclaimer of the subject matter contained therein, and amended claims 9, 13, 24 and 27 to clarify that which Applicant regard as the invention. These amendments do not narrow the scope these claims would have had originally had the correct dependencies been provided. Applicant respectfully submits that the amendments to the claims are fully supported by the originally filed specification.

Entry of the amendments is proper under 37 CFR § 1.116 since the amendments: (a) place the application in condition for allowance for the reasons discussed herein; (b) do not raise any new issue requiring further search and/or consideration; and (c) place the application in better form for appeal, should an appeal be necessary. The amendments are necessary to correct which Applicant regard as the invention. Entry of the amendments is thus respectfully requested.

The Office Action objects the amendments in paragraph 0018, paragraph 0032, and paragraph 0019 under 35 U.S.C. 132(a) because it introduces new matter into the disclosure that is not supported by the original disclosure. The Examiner indicated that these amendments are required in the specification and are applied as follows: (1) in paragraph 0018 and paragraph 0032, the Applicant cancels the new matter "silicon wafer, quartz, or mica" from the specification, and (2) in paragraph 0019, the Applicant cancels the new matter "titanium (iv) butoxide, titanium (iv) tert-butoxide, titanium (iv)

methoxide, or titanium (iv) propoxide" from the specification. Accordingly, Applicant respectfully request that this objection be reconsidered and withdrawn.

The Office Action rejects claims 9, 13, 14, 15 and 24-27 under 35 U.S.C. § 112 as allegedly unpatentable since "the claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention." Applicant respectfully traverses this rejection.

Claims 9, and 24-27 set forth a novel method to synthesize an inverted titania photonic crystal on a substrate exhibiting a photonic stopgap by infiltrating diluted titanium precursor with anhydrous ethanol, into the voids of the organic polymer (i.e. polystyrene) colloidal crystal template on a substrate, by subjecting the organic polymer (i.e. polystyrene) colloidal crystal template on a substrate and diluted titanium precursor with anhydrous ethanol to a gravitational force applied by centrifugation.

The claims 9, and 24-27 were described in the written description of the specification in step by step manner as it was carried out by the inventor, and were written in full, clear, concise, and exact terms, in order for any person skilled in the art to make and use the same. The claim 9 is as follows:

"9. (Currently amended) A method of forming an inorganic macroporous material on a substrate exhibiting substantial periodicity, the method comprising the steps of:

providing a colloidal crystal template on a substrate comprising organic polymer particles;

introducing into the interstitial voids of the colloidal crystal template a  
nonecolloidal inorganic diluted titanium precursor with anhydrous ethanol  
composition; and

forming a hardened composite organic-inorganic structure; and

removing the colloidal crystal template from the hardened composite organic-inorganic structure to form an inorganic macroporous material on a substrate.”

The paragraph 0019 was written as follows:

“A centrifuge (~~faleon tube~~) tube was half-filled with a diluted titanium precursor such as titanium(iv) isopropoxide (TiPT), or titanium(iv) ethoxide (TEOT) [[,]] ~~titanium(iv) butoxide, titanium(iv) tert-butoxide, titanium(iv) methoxide, or titanium(iv) propoxide~~ with anhydrous ethanol. Then the polystyrene template on a substrate was dropped into the ~~Faleon~~ centrifuge tube vertically. The degree of dilution is crucial to keep the structure of the template intact. After trying different dilution percentages it was obvious that dilution factors of less than 4 V % had little destructive effect on the polystyrene templates.“

Applicant has mentioned the vessel that was used was a “centrifuge tube” that was “half-filled” with “a diluted titanium precursor such as titanium(iv) isopropoxide (TiPT), or titanium(iv) ethoxide (TEOT), with anhydrous ethanol”. Then the prepared centrifuge tube, inside which the “polystyrene colloidal crystal template on a substrate” was put, was placed inside centrifuge equipment. Also the dilution factor by which the

titanium precursor has to be diluted in order to get the best result has been given to be “4 V %”. Later in paragraph 0020 the speed of the centrifuge equipment is mentioned to be set at “1200 to 3600 rpm” and the time of centrifugation was given to be in the range between “30 to 60 minutes”. Hence from paragraphs 0019 and 0020 these steps about the invention were written: (1) the vessel that was used for infiltration was “a centrifuge tube”, (2) the precursors were used were ” titanium(iv) isopropoxide (TiPT), titanium(iv) ethoxide (TEOT)”, (3) the precursors were diluted with “anhydrous ethanol” with the best dilution factor that was given based on inventor’s experimentation , was given to be “4 V %”, (4) the material that was infiltrated was “a polystyrene colloidal crystal template on substrate”, (5) then it was mentioned that the polystyrene colloidal crystal template on substrate was put inside the “half-filled centrifuge tube” with diluted titanium precursors, and (6) finally the prepared centrifuge tube comprising diluted titanium precursor and polystyrene colloidal crystal template on a substrate were subjected to centrifugal forces at speed of “1200 rpm to 3600 rpm” for “30 to 60 minutes”. These steps that were written in detailed, concise and step-by-step manner were submitted in claims 24, and 25 as follows:

“24. (Currently amended) The method of claim 9 wherein the step of introducing the diluted titanium noncolloidal inorganic precursor with anhydrous ethanol, into the interstitial voids of the colloidal crystal template comprises subjecting the diluted titanium noncolloidal inorganic precursor with anhydrous ethanol and the colloidal crystal template on a substrate to a gravitational force.”

“25. (Previously presented) The method of 24 wherein the gravitational force is applied by centrifugation.”

In paragraph 0021, the Applicant teaches us that after each centrifugation the infiltrated polystyrene colloidal template on a substrate was taken out of the centrifuge tube and was placed on a “loosely closed container” for “6 hours” to form “amorphous titania inside the voids of the polystyrene template” then again the infiltrated polystyrene colloidal template on a substrate was put inside the “half-filled centrifuge tube with diluted titanium precursors” for another infiltration step. In paragraph 0022 the best number of “centrifuge step repetitions was at least 5 times” as was determined by Applicant. The Applicant teaches the method that was used to determine the number of the centrifugation steps that were necessary to fill all the voids inside the template in paragraph 022 as follows:

“Of course, one could repeat the infiltration step until almost all the voids inside the template were filled with the titania. This could be figured out by following UV-VIS characteristics in particular the wavelength of the stop gap on the UV-Vis spectrum as it moved to higher wavelengths (red-shift) with each infiltration step. This is found from the light absorption against wavelength plot produced by a UV-VIS spectrophotometer. When this peak does not move to higher bandwidths anymore it mean all voids inside the template is almost filled.”

In paragraph 0023, the Applicant teaches us how the required concentration that gave the best result was determined experimentally to be “4 V%” as follows:

“The UV-VIS characterization of the films indicated the following. The higher the concentrations of the solutions were the faster the degradation of the films. At the same time the more concentrated the solution was the higher the red-shift jump resulted for the film. So to optimize the infiltration the concentration should be very low. As mentioned above concentrations of 4 V % (4 volume percent) and lower gave very good results.”

In FIG. 1, paragraph 0038, the Applicant showed the UV-Vis spectrum of the synthesized inverted titania photonic crystal film on the substrate that was obtained using the centrifugation method. And, in paragraph 0040, the detailed description of FIG. 1 was given as follows:

“FIG. 1 shows the UV-Vis spectrum determined at normal incidence to the (111) surface of the inverted titania photonic crystal film produced by following closely the steps in the claim section. The significant sharp peak at 425 nm is the stopgap. The sharpness of the stopgap peak is an indication of high quality optical characteristic of the photonic crystal film.”

In the claim 26:

“26. (Previously presented) The method of claim 9 wherein the inorganic macroporous material exhibits a photonic stopgap.”

“the inverted titania photonic crystal on a substrate exhibits a photonic stopgap” that was prepared using the centrifugation method was supported by the “UV-Vis spectrum determined at normal incidence to the (111) surface of the inverted titania photonic crystal film” that was presented in FIG. 1 in which the stopgap is the sharp peak at 425 nm.

In the claim 27:

“27. (Currently amended) The process of claim 9 wherein the substrate comprises glass, indium tin oxide coated glass, fluorine doped tin oxide coated glass [[,]] ~~silicon wafer, quartz, or mica .~~”

the kind of substrates “glass, indium tin oxide coated glass, fluorine doped tin oxide coated glass” on which the inorganic macroporous material was prepared using centrifugation force for infiltration were given. The types of substrates were mentioned in paragraphs 18, and 32 as follows:

“[0018] Negatively charged polystyrene particles were stabilized by using surfactant sodium dodecyl sulfate (SDS). This increases the mechanical stability of the future template by producing necking between the particles. The increased necking between the particles keep the structure stable during infiltration, and also during the ~~ealcinations~~calcination. These particles were used to make polystyrene opals film on a glass, Indium Tin Oxide (ITO), or Fluorine doped Tin Oxide (FTO) [[,]] ~~silicon wafer, quartz, or mica~~ substrate “

“[0032] The result of this procedure is an inverted titania photonic crystal on a substrate such as glass, ITO, FTO coated glass [[,]] ~~silicon wafer, quartz, or mica~~ substrate.”

Hence the claims 9, and 24-27 have already been described in clear, concise and detailed manner for any person skilled in the art to be carried over to obtain the same result as the inventor obtained as they were written in detailed step by step manner in paragraphs 0018, 0019, 0020, 0021, 0022, 0023, 0032, 0038, and 0040 in the specification section.

The claims 13, 14 and 15 were described in the written description of the specification in step by step manner as it was carried out by the inventor, and were written in full, clear, concise, and exact terms, in order for any person skilled in the art to make and use the same. The claims 13, 14 and 15 are as follows:

“13. (Currently amended) The method of claim [[10]] 9 wherein the organic polymer particles comprises surfactant on the surface.”

“14. (Previously presented) The method of claim 13 wherein the surfactant comprises sodium dodecyl sulfate.”

“15. (Previously presented) The method of claim 13 wherein the surfactant fuses the organic polymer particles together.”

The claims 13, 14 and 15 were described in detail in paragraph 0018 of the specification as follows:

“[0018] Negatively charged polystyrene particles were stabilized by using surfactant sodium dodecyl sulfate (SDS). This increases the mechanical stability of the future template by producing necking between the particles. The increased necking between the particles keep the structure stable during infiltration, and also during the ~~calcinations~~ calcination. These particles were used to make polystyrene opals film on a glass, Indium Tin Oxide (ITO), or Fluorine doped Tin Oxide (FTO) [[,]] ~~silicon wafer, quartz, or mica~~ substrate “

In paragraph 0018, the applicant teaches us “polystyrene particles were stabilized by using surfactant sodium dodecyl sulfate (SDS)” to “increases the mechanical stability of the future template” by fusing that is, producing necking between the particles.

Hence the claims 13, 14 and 15 have already been described in full, clear, concise, exact terms and detailed manner in paragraphs 0018 in the specification section, in order for any person skilled in the art to make and use the same.

The Office Action rejects claims 9, 13, 14, 15 and 24-27 under 35 U.S.C. § 112 as allegedly unpatentable since the line 4 of claim 9, and line 1-3 of claim 24 contains the limitation “noncolloidal inorganic precursor” as a negative limitation that did not have basis in the original disclosure. Applicant respectfully requests that this rejection be reconsidered and withdrawn for amended claims 9, and 24.

In line 4 of claim 9 the “noncolloidal inorganic precursor” were replaced with “diluted titanium precursor with anhydrous ethanol”, which have basis in the original disclosure of specification in paragraph 0019 as follows:

“[0019] A centrifuge (~~Falcon tube~~) tube was half-filled with a diluted titanium precursor such as titanium(iv) isopropoxide (TiPT), or titanium(iv) ethoxide (TEOT) ~~[[,]] titanium(iv) butoxide, titanium(iv) tert butoxide, titanium(iv) methoxide, or titanium(iv) propoxide with anhydrous ethanol.~~”

In line 1-3 of claim 24 the “noncolloidal inorganic precursor” were replaced with “diluted titanium precursor with anhydrous ethanol”, which have basis in the original disclosure of specification in paragraph 0019 as follows:

“[0019] A centrifuge (~~Falcon tube~~) tube was half-filled with a diluted titanium precursor such as titanium(iv) isopropoxide (TiPT), or titanium(iv) ethoxide (TEOT) ~~[[,]] titanium(iv) butoxide, titanium(iv) tert butoxide, titanium(iv) methoxide, or titanium(iv) propoxide with anhydrous ethanol.~~”

In view of the foregoing, it is respectfully submitted that claims 9, 13, 14, 15 and 24-27 are in condition for allowance and the written description requirement under 35 U.S.C. § 112, first paragraph, is complied. Favorable reconsideration and prompt allowance of claims 9, 13, 14, 15 and 24-27 are earnestly solicited.

The Office Action rejects claims 9, 13, 14, 15 and 24-27 under 35 U.S.C. § 112, second paragraph as allegedly unpatentable since 9, 13, 14, 15 and 24-27 are “indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.” Applicant respectfully traverses this rejection.

The second paragraph of 35 U.S.C. § 112:

“The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.”

According to paragraphs 0033, 0034, 0035, 0036, and 0037 in the specification, the applicant had complied with the written description of the second paragraph of 35 U.S.C. § 112, since the specification had been concluded with the “claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.” The paragraphs 033, 0034, 0035, 0036, and 0037 were written in the description as follows:

“[0033] The parts that are unique in this invention are as follows:

[0034] 1) Using centrifugation as a method to infiltrate uniformly from top to bottom inside the polystyrene template on a substrate;

[0035] 2) Taking low concentrations (less than 4V %) of alkoxides to infiltrate polystyrene template with repetitions so keeping the voids openings of the template open for more infiltration steps;

[0036] 3) Ability to repeat infiltration of the template uniformly many times;

[0037] 4) Using negatively charged surfactant stabilized polystyrene spheres with sulfate functional group to make a photonic crystal template on substrate to produce necking between the particles. The necking would benefit the resulting inverse titania film in two ways; it stabilizes the template during infiltration and then during calcination and facilitates removal of the template.“

In line 4 of claim 9, and line 2 of claim 24, the term “interstitial” was deleted, since it did not have the antecedent basis in the original disclosure of specification.

In view of the foregoing, it is respectfully submitted that claims 9, 13, 14, 15 and 24-27 are in condition for allowance and the written description requirement under 35 U.S.C. § 112, second paragraph, is complied. Favorable reconsideration and prompt allowance of claims 9, 13, 14, 15 and 24-27 are earnestly solicited.

The Office Action rejects claims 9, 13, 14, 15 and 24-27 under 35 U.S.C. § 103(a) as allegedly unpatentable over Holland et al., “Synthesis of Macroporous Minerals with Highly Ordered Three-Dimensional arrays of Spherical Voids”, in view of U.S. Patent 6,139,626 to Norris et al. and in view of US 2004/0026324 A1 (Lucas). Applicant respectfully traverses this rejection.

Claims 9, and 24-27 set forth a novel method to synthesize an inverted titania photonic crystal on a substrate exhibiting a photonic stopgap by infiltrating diluted titanium precursor with anhydrous ethanol, into the voids of the organic polymer (i.e. polystyrene) colloidal crystal template on a substrate, by subjecting the organic polymer (i.e. polystyrene) colloidal crystal template on a substrate and diluted titanium precursor with anhydrous ethanol to a gravitational force applied by centrifugation.

The claims 13, 14, and 15 set forth that the organic polymer that is, polystyrene colloidal particles that were used to make the template has sodium dodecyl sulfate surfactant on the surface to fuse the polystyrene colloidal crystal particles together by producing necking between the particles and hence increasing the mechanical stability of the polystyrene colloidal crystal template.

Holland teaches to use “vacuum” to synthesize macroporous minerals powder using metal alkoxides, filter paper and latex spheres deposited on filter paper as template. Specifically, Holland teaches that the alkoxides were added to the “latex spheres” “in a Buchner funnel under vacuum” “while suction was applied.” See Holland (scheme 1) and page 539. Holland teaches only to use “vacuum” to make macroporous minerals powder. Holland does not disclose, teach or suggest the template is a colloidal crystal template on a substrate as is admitted by Office Action at page 5.

Norris does not disclose, teach or suggest, “a colloidal crystal template is on the glass or semiconductor or ceramic substrate” as was submitted in Office Action at page 5. Applicant respectfully disagrees with this assertion.

Norris teaches a method to use prepared “colloidal nanocrystals for incorporation into the template” (col.5 lines 54-67; col. 6 lines 3-47), where the “template material” is

“silica” or “other materials, including, but not limited to, glasses, polymers, semiconductors, ceramics, metals, and biomaterials would be suitable, depending on the final material desired.” Norris teaches what types of materials can be used to make the template “The template material must also be chemically compatible with the solvent used to disperse the nanocrystals; that is, the template must be insoluble and unreactive in this solvent. If the nanocrystals are to be sintered after filling the template (as will be described below), the template must further have a melting temperature higher than the melting temperature of the nanocrystals. If the template is to be eliminated or replaced after filling, a process must also be known for easy removal of the template from the structure. An example of a template material which satisfies all of the above criteria and is discussed further below, is silica. However, other materials, including, but not limited to, glasses, polymers, semiconductors, ceramics, metals, and biomaterials would be suitable, depending on the final material desired.” (col.5 lines 54-67; col. 6 lines 3-47).

Applicant respectfully submits that as recited in claim 9, and claim 27, “colloidal crystal template is on a substrate”, that the polystyrene colloidal crystal template is on a substrate, nowhere suggested, disclosed or taught by Norris. Holland does not disclose, teach or suggest the template is a colloidal crystal template on a substrate as is admitted by Office Action at page 5, and Norris nowhere suggested, disclosed or taught that the colloidal template is on a substrate. One of ordinary skill in the art would not have been motivated by Norris to modify Holland to make the polystyrene colloidal crystal template on a substrate, as recited in 9, 13, 14, 15 and 24-27, for the reasons that, Holland does not disclose, teach or suggest the template is a colloidal crystal template on a substrate as is

admitted by Office Action at page 5, and Norris does not provide any teaching regarding that the template is on a substrate.

With respect to claims 13, 14 and 15, the polystyrene colloidal crystal template on a substrate comprises sodium dodecyl sulfate surfactant on the surface to fuse the polystyrene colloidal crystal particles together by producing necking between the particles, as recited in claims 13, 14 and 15. Neither Holland nor Norris discloses, teaches or suggests using sodium dodecyl sulfate surfactant on the surface to fuse the polystyrene colloidal crystal particles together by producing necking between the particles. Holland does not disclose, teach or suggest, “the organic particles comprise surfactant on the surface to fuses the particles together” as is admitted by Office Action at page 6.

Norris nowhere suggested, disclosed or taught that the surfactant was used to fuse the individual particles together. Applicant respectfully disagrees with this assertion.

Norris teaches preparation of “colloidal nanocrystals” (col. 6 lines 3-47), “for incorporation into the template.” He teaches that the colloidal nanocrystals are “stabilized by a chemical agent known as the “surface cap.” In (col. 6 lines 3-47) Norris teaches, “The surface cap is a molecule which serves two purposes. One end of the molecule electronically passivates the particles by binding to surface atoms and thereby satisfying dangling bonds. The other end provides a steric barrier to agglomeration and gives the particles its solubility properties. In general, surfactants can satisfy this role; in the examples below, the surface caps are trialkyl phosphines and trialkyl phosphine oxides.” Norris teaches the surfactants on the surface of the colloidal nanocrystals was used to prevent the individual particles from agglomerating to each other in order to keep them away from coagulation, that is away from fusing and necking to each other so the

colloidal nanocrystals can be kept monodisperse as is specifically disclosed in Norris, at (col. 6 lines 3-47), "By preventing the individual particles from agglomerating, the surface cap maintains the discrete nature of each particle, which ensures that the particles (that is, the nanocrystals) flow into the pores of the template." With respect to claims 13, 14 and 15, the polystyrene colloidal crystal template on a substrate comprises sodium dodecyl sulfate surfactant on the surface to fuse the polystyrene colloidal crystal particles together by producing necking between the particles, as recited in claims 13, 14 and 15, Norris does not provide any teachings regarding using sodium dodecyl sulfate surfactant on the surface to fuse the polystyrene colloidal crystal particles together by producing necking between the particles. Holland does not disclose, teach or suggest using sodium dodecyl sulfate surfactant on the surface to fuse the polystyrene colloidal crystal particles together as is admitted by Office Action at page 6, and Norris nowhere suggested, disclosed or taught that the surfactant was used to fuse the individual particles together. One of ordinary skill in the art would not have been motivated by Norris to modify Holland to use sodium dodecyl sulfate surfactant on the surface to fuse the polystyrene colloidal crystal particles together by producing necking between the particles, as recited in claims 13, 14 and 15.

With respect to claim 27, the Office Action asserts that Norris teaches "the substrate comprises glass or semiconductor substrate (page 6 lines 10-16). Applicant respectfully disagrees with this assertion.

Norris does not disclose, teach or suggest, "a colloidal crystal template is on the glass or semiconductor or ceramic substrate" as was submitted in Office Action at page 5. Applicant respectfully disagrees with this assertion.

Norris teaches a method to use prepared “colloidal nanocrystals for incorporation into the template” (col.5 lines 54-67; col. 6 lines 3-47), where the “template material” is “silica” or “other materials, including, but not limited to, glasses, polymers, semiconductors, ceramics, metals, and biomaterials would be suitable, depending on the final material desired.” Norris teaches what types of materials can be used to make the template “The template material must also be chemically compatible with the solvent used to disperse the nanocrystals; that is, the template must be insoluble and unreactive in this solvent. If the nanocrystals are to be sintered after filling the template (as will be described below), the template must further have a melting temperature higher than the melting temperature of the nanocrystals. If the template is to be eliminated or replaced after filling, a process must also be known for easy removal of the template from the structure. An example of a template material which satisfies all of the above criteria and is discussed further below, is silica. However, other materials, including, but not limited to, glasses, polymers, semiconductors, ceramics, metals, and biomaterials would be suitable, depending on the final material desired.” (col.5 lines 54-67; col. 6 lines 3-47).

Applicant respectfully submits that as recited in claim 9, and claim 27, “colloidal crystal template is on a substrate”, that the polystyrene colloidal crystal template is on a substrate, nowhere suggested, disclosed or taught by Norris. Holland does not disclose, teach or suggest the template is a colloidal crystal template on a substrate as is admitted by Office Action at page 5, and Norris nowhere suggested, disclosed or taught that the colloidal template is on a substrate. One of ordinary skill in the art would not have been motivated by Norris to modify Holland to make the polystyrene colloidal crystal template on a substrate, as recited in 9, 13, 14, 15 and 24-27, for the reasons that, Holland does not

disclose, teach or suggest the template is a colloidal crystal template on a substrate as is admitted by Office Action at page 7, and Norris does not provide any teaching regarding that the template is on a substrate.

With respect to claim 24, the step of introducing the diluted titanium precursor with anhydrous ethanol, into the voids of the polystyrene colloidal crystal template on a substrate, comprises subjecting the polystyrene colloidal crystal template on a substrate and diluted titanium precursor with anhydrous ethanol to a gravitational force as recited in claim 24.

The Office Action asserts that Holland teaches to use gravitational force to introduce inorganic precursor into the voids of the colloidal crystal template. Applicant respectfully disagrees with this assertion. Holland teaches to use “vacuum” not gravitational force, to synthesize macroporous minerals powder using metal alkoxides, filter paper and latex spheres deposited on filter paper as template. Specifically, Holland teaches that the alkoxide “was added dropwise to cover the latex spheres completely while suction was applied.” See Holland (scheme 1) and page 539. Holland teaches only a vacuum method of making macroporous minerals powder. In contrast to claim 24, Holland does not disclose, teach or suggest the use of gravitational force to introduce diluted titanium precursor with anhydrous ethanol, into the voids of the polystyrene colloidal crystal template on a substrate, by subjecting the polystyrene colloidal crystal template on a substrate and diluted titanium precursor with anhydrous ethanol to a gravitational force. Applicant respectfully submits that Holland does not disclose, teach or suggest gravitational force to introduce inorganic precursor into the voids of the colloidal crystal template.

The Office Action rejects claim 25 under 35 U.S.C. § 103(a) as allegedly unpatentable over Holland et al., “Synthesis of Macroporous Minerals with Highly Ordered Three-Dimensional arrays of Spherical Voids”, in view of U.S. Patent 6,139,626 to Norris et al. and in view of US 2004/0026324 A1 (Lucas). Applicant respectfully traverses this rejection.

With respect to claim 25, the step of introducing the diluted titanium precursor with anhydrous ethanol, into the voids of the polystyrene colloidal crystal template on a substrate, comprises subjecting the polystyrene colloidal crystal template on a substrate and diluted titanium precursor with anhydrous ethanol to a gravitational force applied by centrifugation as recited in claim 25.

Neither Holland nor Norris discloses, teaches or suggests using gravitational force applied by centrifugation as is admitted by Office Action at page 8. The Office Action asserts that Holland teaches to use gravitational force to introduce inorganic precursor into the voids of the colloidal crystal template. Applicant respectfully disagrees with this assertion. Holland teaches to use “vacuum” not gravitational force, to synthesize macroporous minerals powder using metal alkoxides, filter paper and latex spheres deposited on filter paper as template. Specifically, Holland teaches that the alkoxide “was added dropwise to cover the latex spheres completely while suction was applied.” See Holland (scheme 1) and page 539. Holland teaches only to use “vacuum” to make macroporous minerals powder. In contrast to claim 25, Holland does not disclose, teach or suggest the use of gravitational force to introduce diluted titanium precursor with anhydrous ethanol, into the voids of the polystyrene colloidal crystal template on a substrate, by subjecting the polystyrene colloidal crystal template on a substrate and

diluted titanium precursor with anhydrous ethanol to a gravitational force. Applicant respectfully submits that Holland does not disclose, teach or suggest gravitational force to introduce inorganic precursor into the voids of the colloidal crystal template.

Lucas teaches “to use centrifugation in order to separate the solid material (paragraph 0066, 0083)” because “it will help to separate the solid material” as is admitted by Office Action at page 8. Specifically, Lucas teaches that “the precipitate was separated by centrifugation” in paragraph 0066 “A lilac coloured precipitate formed immediately and after the mixture had been stirred for about 10 minutes, the precipitate was separated by centrifugation and the supernatant solution was discarded.” Lucas teaches only to use centrifugation to separate the precipitate from the supernatant solution comprising the precipitate and the supernatant solution. In contrast to claim 25, Lucas does not disclose, teach or suggest the use of centrifugation to introduce diluted titanium precursor with anhydrous ethanol, wherein the titanium precursor is dissolved completely in anhydrous ethanol, into the voids of the polystyrene colloidal crystal template on a substrate, by subjecting the polystyrene colloidal crystal template on a substrate and diluted titanium precursor with anhydrous ethanol to centrifugal forces. Applicant used a diluted titanium precursor with anhydrous ethanol, wherein the titanium precursor is dissolved completely in anhydrous ethanol, where the anhydrous ethanol was used for dilution purpose and not to precipitate out the titanium precursor, so there is no precipitate (i.e., no solid) in the solution. Hence a clear diluted solution with no solid in it, was used to infiltrate the voids of the polystyrene colloidal crystal template on a substrate, using centrifugation to infiltrate uniformly all the voids inside of the polystyrene colloidal crystal template from top to bottom. The centrifuge tube comprising

diluted titanium precursor with anhydrous ethanol and polystyrene colloidal crystal template on a substrate inside it is subjected to gravitational forces by applying centrifugation. The high-speed centrifugation is used to create centrifugal forces that increase the fluid velocity. Hence, the flow of the diluted titanium precursor such as titanium (iv) isopropoxide (TiPT), or titanium (iv) ethoxide (TEOT) with anhydrous ethanol inside the voids of the polystyrene colloidal crystal template is accelerated by centrifugal forces and that leads to increase permeability and forcing of diluted titanium precursor such as titanium (iv) isopropoxide (TiPT), or titanium (iv) ethoxide (TEOT) with anhydrous ethanol inside the voids of the polystyrene colloidal crystal template on a substrate and therefore increased and uniform infiltration of the voids inside the polystyrene colloidal crystal template on the substrate. Applicant respectfully submits that Lucas does not disclose, teach or suggest centrifugation to introduce titanium precursor into the voids of the colloidal crystal template. Neither Holland nor Norris discloses, teaches or suggests using gravitational force applied by centrifugation as is admitted by Office Action at page 8. Lucas nowhere suggested, disclosed or taught centrifugation to introduce titanium precursor into the voids of the colloidal crystal template. One of ordinary skill in the art would not have been motivated by Lucas to modify Holland and Norris to use centrifugation to introduce titanium precursor into the voids of the colloidal crystal template as recited in claim 25.

The Office Action rejects claim 26 under 35 U.S.C. § 103(a) as allegedly unpatentable over Holland et al., “Synthesis of Macroporous Minerals with Highly Ordered Three-Dimensional arrays of Spherical Voids”. Applicant respectfully traverses this rejection.

With respect to claim 26, the inverted titania photonic crystal on a substrate that is synthesized by introducing the diluted titanium precursor with anhydrous ethanol, into the voids of the polystyrene colloidal crystal template on a substrate, by subjecting the polystyrene colloidal crystal template on a substrate and diluted titanium precursor with anhydrous ethanol to a gravitational force applied by centrifugation as recited in claim 25, exhibits a photonic stopgap as recited in claim 26. The Office Action asserts that Holland “discloses the macroporous material have applications in photocatalysis (page 538, read on photonic stopgap).” as is admitted by the Office Action at page 6.

Holland teaches the resulting materials have application in area of “photocatalysis” as is admitted by the Office Action at page 6. But photocatalysis is an application that the resulting material can be used for and it is not the characteristic property of the material. The photonic stopgap is the characteristic property of the material, and has nothing to do with photocatalysis. Photocatalysis and photonic stopgap are not the same. Applicant shows the photonic stopgap peak at 425 nm at FIG.1, which is determined at normal incidence to the (111) surface of the inverted titania photonic crystal film. The significant sharp peak at 425 nm is the stopgap (paragraph 0041). Holland teaches only the application of the macroporous material is in area of photocatalysis as is admitted by the Office at page 6. Applicant respectfully submits that in contrast to claim 26, Holland does not disclose, teach or suggest nowhere in Holland et al., “Synthesis of Macroporous Minerals with Highly Ordered Three-Dimensional arrays of Spherical Voids”, that the macroporous material has a photonic stopgap.

Therefore, for at least the reasons outlined above, the combinations of Holland and either Norris or Lucas fail to teach, disclose or suggest all of the features recited in

claims 9, 13, 14, 15 and 24-27. Accordingly, the combinations of Holland and either Norris or Lucas, cannot render claims 9, 13, 14, 15 and 24-27 obvious under 35 U.S.C. § 103(a). Furthermore, the written description requirement for the claims 9, 13, 14, 15 and 24-27 under 35 U.S.C. § 112, first paragraph, is complied. Withdrawal of the rejection of claims 9, 13, 14, 15 and 24-27 as unpatentable under 35 U.S.C. § 112, and over the combinations of Holland and either Norris or Lucas is respectfully requested.

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Applicant respectfully request that the Examiner reconsider and withdraw all outstanding objections and rejections. Favorable reconsideration and prompt allowance of claims 9, 13, 14, 15 and 24-27 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the address set forth below.

Respectfully submitted,



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